

Guidelines for general anaesthesia in the elderly of the Committee on Quality and Safety in Anaesthesia, Polish Society of Anaesthesiology and Intensive Therapy

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The prolongation of the human lifespan, one of the most important achievements of modern medicine, has led to a rapid increase in the number of elderly people (according to the current definition, this refers to those over 65 years of age). The incidence of anaesthesia and surgery in elderly patients is assumed to be four-fold higher compared to the remaining general population [1]. It is estimated that within the next ten years the demands for invasive procedures will increase by 25%, whereas the geriatric population will grow by about 50% [2]. Consequently, the demands for anaesthesia in the elderly will increase.

Elderly people require specific management adjusted to the natural processes of ageing, higher prevalence of co-existing pathologies, and different responses to medicines used in the perioperative period. The pathophysiological changes associated with natural ageing affect all the organs and tissues, especially those in the cardiovascular, respiratory, urinary and central nervous systems. At a rough estimate, the competence of internal organs diminishes by 1% per one year of life over the age of 40 [3].

RISK ASSESSMENT

The decision concerning surgery and anaesthesia should not be solely based on a patient's age; the risk-benefit ratio ought to be assessed. Four main independent risk factors are considered the indicators of possible risk of surgery in patients over the age of 65: age, general condition and co-existing illnesses (according to the ASA scale), urgency of surgery (scheduled or emergent), and type of surgical procedure.

Advanced age is a risk factor of possible anaesthetic complications and major incidents in the post-surgery recuperation period [4]. It should be stressed, however, that age itself is responsible only for a slight increase in anaesthetic complications, which are much more related to the urgency of surgery and severity of other systemic diseases [2, 5].

PATIENT PREPARATION FOR ANAESTHESIA

The success of anaesthetic and surgical procedures depends not only on proper and skilful performance, but also on suitable preparation of patients for surgery and anaesthesia, and in particular patients with concomitant diseases.

1. In scheduled procedures, preparation for anaesthesia should be started early.
2. Strategies to reduce surgery-related cardiovascular complications using β -adrenolytics, statins or angiotensin convertase inhibitors should be optimally introduced four weeks prior to anaesthesia (seven days as a minimum) [2]; therefore, co-operation between the hospital personnel and GPs as well as early patient visits to the anaesthesiological outpatient clinic are required.
3. In cardiovascularly compromised patients, preparation for surgery/anaesthesia and optimisation of the patient's condition should be consistent with the guidelines of the European Society of Cardiology and European Society of Anaesthesiology [2].
4. Optimisation of the patient's condition and preparation of patients with severe chronic diseases should be based on co-operation with a suitable specialist.

ADDITIONAL TESTS CONDUCTED PRIOR TO ANAESTHESIA

In the majority of cases, the following tests are recommended:

1. Peripheral blood tests, including lymphocyte count (to evaluate potential malnutrition).

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2. Serum concentrations of sodium, potassium, chlorides, urea and creatinine.
3. Fasting blood sugar.
4. Resting 12-lead ECG.
5. Chest X-ray.

In individual cases, it is necessary to widen the spectrum of tests and consultations, depending on the kind and severity of diseases.

Since the muscle mass in the elderly decreases, the renal function should be assessed based on serum concentrations of creatinine and urea as well as renal filtration, which is best determined by the Cockcroft-Gault formula [6]:

$$\text{Creatinine clearance} = \frac{[140 - \text{age (years)}] \times \text{body mass (kg)}}{\text{Serum creatinine (mg dL}^{-1}) \times 72} \times C$$

C — constant: women = 0.85; men = 1.0.

CONSENT FOR ANAESTHESIA

According to the Medical and Dental Practitioners Act, the patient should give conscious and voluntary informed consent for any medical procedure, including anaesthesia. In cases of patients incapable of providing such consent due to quantitative or qualitative consciousness deficits, the consent is given by the statutory representative or, in his or her absence, by the Guardianship Court with jurisdiction over the place of procedure. It should however be remembered that if the patient is legally incapacitated, but still able to consciously communicate his or her will, it is necessary to obtain an additional consent from him or her [7].

PREMEDICATION

The available literature does not prove beyond all doubt that routine premedication is beneficial to elderly patients [8]. Any decision-making concerning administration and type of premedication in this age group should consider the following factors:

1. The decision regarding pharmacological premedication ought to be made on an individual basis, taking into consideration the physical and psychological condition of the patient, possible side effects of administered medicines and their interactions with the drugs already used by the patient for chronic conditions.
2. Possible premedication-related side effects should be taken into account, especially paradoxical stimulation and impaired respiration or circulation (monitoring should be provided in the patient's ward).
3. Extremely anxious patients can receive an anxiolytic (usually a short-action benzodiazepine).
4. Midazolam should be used with great caution due to increased risk of respiratory depression or arrest, even at very low doses.

5. In highly aroused patients, oral olanzapine or a small dose of lorazepam may be considered [9].
6. Since the patient's reactions, even to reduced doses of premedication agents, are unpredictable, enhanced surveillance after their administration and during transport to the surgical ward is required.

During the pre-surgery visit, the physician should discuss not only possible premedication, but also pre-surgical liquid supply, especially in patients who are not anaesthetised and operated on first. There are no contraindications for small amounts of clear liquids 2–3 hours prior to anaesthesia, unless patients suffer from severe diabetes and/or chronic renal failure, due to gastropathy that accompanies such conditions.

INDUCTION OF ANAESTHESIA

Induction of anaesthesia in elderly patients can be particularly difficult during general anaesthesia. Patients over 65 years of age display high variability in their responses to induction drugs especially *i.v.* anaesthetics. Compared to the younger population, the doses should be lower due to decreased volume of distribution [1]. It is recommended to monitor meticulously the patient's cardiac parameters during induction.

1. Due to decreased functional residual capacity, the pre-oxygenation period should be longer.
2. Doses of opioids used for induction (fentanyl, sufentanil) do not have to be reduced considerably compared to the doses administered to younger patients [8]. Nevertheless, the utmost care should be taken during administration of remifentanyl or the initial dose of remifentanyl abandoned due to the risk of circulatory depression and chest wall rigidity.
3. The Polish Society of Anaesthesiology and Intensive Therapy recommends inhaled induction in elderly patients [11]. Sevoflurane is particularly suited for inhaled induction and it is well tolerated by elderly patients [12–14].
4. Irritation of the airway caused by desflurane significantly limits its use in anaesthesia induction. Desflurane should not be used for induction in patients with increased risk of ischaemic heart disease or in any cases where increased heart rate and blood pressure are contraindicated.
5. The slightest circulatory depression is observed after *i.v.* etomidate; however its administration (as with that of ketamine) should be carefully considered, especially in patients with circulatory instabilities.
6. Doses of thiopental and propofol used in anaesthetic induction should be decreased by 30–40% in comparison to those used in younger patients.
7. Intravenous anaesthetic titration appears to be the optimal method of administration to obtain the required

clinical effect (e.g. suppression of eyelash reflex) or suitable BIS value at the lowest dosage possible.

8. The onset of action of non-depolarising muscle relaxants is delayed in elderly patients, so lung ventilation via a facemask may have to be provided for a longer time [3, 15].
9. When suxametonium is used, its reduced doses are not required. In patients with low cardiac output, the onset of drug effects may be delayed. Even though the activity of butyrylcholinesterase is decreased in elderly patients, the clinical findings do not show prolonged block after this depolarising agent [16].

In addition to correct selection of all the agents and pharmaceuticals used for anaesthesia induction, it is necessary to consider the problems that may be associated with lung ventilation via a facemask and laryngeal intubation. Decreased mobility of the cervical spine may hinder optimal head placement. In patients with severely obstructed cervical arteries, and whose cerebral circulation is mainly dependent on the blood flow via the spinal arteries, excessive head movements should be avoided. Special care must be taken during laryngeal intubation in patients with moving or shifting teeth.

The use of a laryngeal mask and other supralaryngeal airway devices in elderly patients is an alternative safe method of securing the airways, unless there are specific contraindications [17]. Compared to propofol, sevoflurane used for anaesthesia induction before the placement of a laryngeal mask has been demonstrated to reduce the risk of adverse circulatory effects and apnoea [18].

MAINTENANCE OF ANAESTHESIA

Maintenance of anaesthesia, as with its induction, requires proper adjustment of drug doses to the patient's age and biological condition. The optimal solution includes anaesthesia depth monitoring (using BIS or entropy) and administration of the smallest doses that will maintain the required anaesthesia level with the proper circulatory function preserved. It is estimated that a BIS level of 50–60 is optimal for maintaining anaesthesia in the elderly, compared to that of about 45 which is optimal for younger patients [6, 19].

1. It appears that anaesthesia maintenance with inhaled sevoflurane, desflurane or isoflurane is optimal for elderly patients. Moreover, halogen inhaled anaesthetics enable continuous monitoring of anaesthetic end-expiratory concentration and have possible protective effects on vital organs, especially the heart, which results in decreased perioperative mortality and morbidity [20].
2. MAC and MAC-awake of halogen agents drop by 4–5% for every decade of life over the age of 40, thus their concentrations should be adjusted to the patient's age [21, 22].

3. A sudden increase in desflurane concentration in the inhalation mixture should be avoided due to the risk of sympathetic nervous system stimulation and resultant elevated arterial blood pressure and increased myocardial oxygen demand.
4. Desflurane should not be administered to patients with obstructive diseases (e.g. chronic obstructive pulmonary disease, asthma) as it can result in bronchospasms.
5. Nitrous oxide should be used for anaesthesia maintenance with due caution in patients with impaired circulatory function, as its cardiodepressive effects are likely to decrease arterial blood pressure [3].
6. The maintenance dose of propofol should be adequate to the dose used for anaesthesia induction. The dose is usually decreased by 50% compared to the maintenance dose used in younger patients. If the infusion guided by target concentration is used, the Schnider's model, taking into account the patient's age, is recommended [23].
7. The remifentanil dose used in infusion should be reduced to 30–40% of the dose used in younger patients due to increased risk of cardiovascular complications, resulting from the small volume of distribution of this opioid, decreased clearance and increased susceptibility of elderly patients.
8. It is recommended to reduce the doses of other opioids by 40–50% compared to the doses used in young patients.
9. Pharmacokinetics of atracurium and cisatracurium does not change with age, so there is no need to adjust the dosages. Decreased metabolism of pancuronium, vecuronium and rocuronium is likely to prolong their time of action [3, 4].

SPECIFIC INTRAOPERATIVE PROBLEMS

1. Elderly patients are more prone to intraoperative hypothermia that increases hospital morbidity and mortality. Therefore, some preventive measures are required (maintaining proper temperature in the operating room, patient warming, infusion fluid heating).
2. The strategy of intraoperative fluid therapy based on administration of balanced fluids should be tailored to a particular surgical procedure and the patient's condition, and to a lesser degree to the patient's age [8].
3. The decision to transfuse red blood cells or otherwise should be based on the assessment of myocardial ischaemia-related clinical symptoms, including haemodynamic instability, tachycardia or ECG changes. The haemoglobin concentration and peripheral blood haematocrit are insufficient to make such a decision. Moreover, determinations of haemoglobin oxygen saturation in mixed venous or superior vena cava blood may prove useful.
4. Special procedures, such as controlled hypotension or normovolemic haemodilution should be used with great

caution due to possible disturbances in autoregulation of blood flow in some vital organs resulting in their ischaemia and secondary failure.

ANAESTHESIA WITHDRAWAL

The altered physiological conditions, as well as different pharmacokinetics and pharmacodynamics in elderly patients, can prolong their recovery from anaesthesia even at reduced doses of anaesthetics; in some cases artificial lung ventilation is required in the immediate postoperative period.

One of the most important problems of the aforementioned postoperative period is the restoration of proper neuromuscular junction function and prevention of residual paralysis that may cause postoperative pulmonary complications.

1. It is recommended to use intraoperative monitoring of the neuromuscular blockage level and to extubate the trachea after it has fully subsided.
2. Acetylcholinesterase inhibitors may be safely used in elderly patients. However, their adverse effects must be taken into account. Moreover, it should be remembered that administration of ACE inhibitors and obligatory atropine might induce postoperative cognitive disorders and confusion.
3. Reversal of rocuronium-induced neuromuscular block with sugammadex appears preferable, but this method is not recommended for patients with renal insufficiency [24].

All elderly patients ought to be meticulously observed and closely monitored in recovery rooms and postoperative care units.

POSTOPERATIVE PAIN MANAGEMENT

Postoperative pain treatment is a challenging task, due to a smaller safety margin of analgesics and difficulties in pain assessment associated with patient confusion and age-related nociceptive disorders.

1. Postoperative pain assessment using routine scales may be difficult or even impossible in some elderly patients.
2. It is recommended to use specific methods of pain assessment based on observation of patients at rest and on movement (e.g. the MOBID Scale — Mobilisation Observation Behaviour Intensity Dementia) [25, 26].
3. The detailed principles of postoperative pain management should be based on information found in geriatric anaesthesia and pain medicine handbooks [27, 28].

SPECIFIC POSTOPERATIVE PROBLEMS

Patients over the age of 65 are at a particularly high risk of postoperative confusion (delirium) and cognitive disorders (PCD — Postoperative Cognitive Dysfunction) [29, 30].

CONFUSION

1. Frequency of confusion incidents ranges from 35% to 70% after some procedures.
2. An extremely high risk of PCD is associated with midazolam.
3. The other risk factors include hypoxia, anticholinergic drugs, impaired metabolism of sodium and potassium, abnormal glucose levels, alcohol abuse, infections, dehydration, sleep, visual and auditory disorders.
4. In such cases, the risk factors should be early identified, reversible causes treated and pharmacotherapy administered (haloperidol or other neuroleptics such as olanzapine or risperidone; in some cases, lorazepam although with caution).

COGNITIVE DISORDERS

1. Cognitive disorders develop during the postoperative period in about 25% of patients over the age of 65.
2. The most common risk factors are hypoxia, hypotension, general anaesthesia, increased perioperative stress, glucocorticosteroids and drugs affecting the cholinergic system.
3. It is essential to avoid situations and drugs that are risk factors of PCD.

The guidelines presented in this paper set out the general rules of anaesthesia in elderly patients. In cases of age-specific diseases, the guidelines published in geriatric anaesthesiology handbooks [3, 31, 32] and papers [9, 16, 33–35] are recommended. The above guidelines do not cover perineural anaesthesia and its usefulness in the elderly. Furthermore, monitored anaesthesiological supervision, sedation and analgosedation have not been considered. All these complex issues should be further analysed and suitable guidelines designed.

CONFLICT OF INTEREST

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